

CLAIMS:

1. A crash-safe vehicle control system for controlling an own vehicle, comprising:

5 an object-information obtaining device operable to obtain object information on each of at least one preceding object existing in front of the own vehicle, the object information including information relating to a position of each preceding object relative to the own vehicle;

10 an operating device operable in the presence of a high possibility of crashing of the own vehicle with one of said at least one preceding object; and

15 a crash-safe control device operable to control the operating device on the basis of the object information on said at least one preceding object obtained by the object-information obtaining device,

and wherein said crash-safe control device is operable to effect at least one of: (a) a non-first-preceding-object-information-dependent control of said operating device, on the basis of non-first-preceding-object information obtained by said object-information obtaining device, in the presence of a high possibility of crashing of the own vehicle with a first preceding vehicle which is one of said at least one preceding object and which exists immediately in front of the own vehicle, the non-first-preceding-object information relating to at least one non-first preceding object each of which is one of said at least one preceding object and exists in front of the first preceding vehicle, and (b) a width-related-information-dependent control of said operating device on the basis of width-related information relating to at least one of a width and a widthwise position of at least one specific object selected from said at least one preceding object.

2. The crash-safe vehicle control system according to claim 1, wherein the crash-safe control device is operable to effect at least the non-first-preceding-object-information-dependent control.

3. The crash-safe vehicle control system according to claim 2, wherein the object-information obtaining device includes an object-information obtaining radar device operable to detect a plurality of preceding objects which exist in front of the own vehicle and which lie on an own lane on which the own vehicle is to run, the object-information obtaining radar device being

operable to obtain the object information on each of said at least one preceding object.

4. The crash-safe vehicle control system according to claim 3, wherein the
5 object-information obtaining radar device of the object-information obtaining
device is a millimeter wave type radar device.

5. The crash-safe vehicle control system according to any one of claims 2-4,
wherein the object-information obtaining device is operable to obtain, as the
10 object information, at least one of a distance, a relative angle and a relative
speed between each of the at least one preceding object and the own vehicle.

6. The crash-safe vehicle control system according to any one of claims 2-5,
wherein the object-information obtaining device obtains the information on
15 the first preceding vehicle, as the object information on one of said at least
one preceding object, and the crash-safe control device is operable to control
the operating device on the basis of the information on the first preceding
vehicle, which has been obtained by the object-information obtaining device.

20 7. The crash-safe vehicle control system according to any one of claims 2-6,
wherein the crash-safe control device is operable to estimate a possibility of
crashing between the first preceding vehicle and said at least one non-first
preceding object, and control the operating device on the basis of the
25 estimated possibility of crashing between the first preceding vehicle and the
at least one non-first preceding object.

8. The crash-safe vehicle control system according to claim 7, wherein the
object-information obtaining device obtains, as the object information on the
at least one non-first preceding object, the information on a second preceding
30 vehicle existing immediately in front of the first preceding vehicle, and the
crash-safe control devices is operable to estimate a possibility of crashing
between the first and second preceding vehicles, and control the operating
device on the basis of the estimated possibility of crashing between the first
and second preceding vehicles.

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9. The crash-safe vehicle control system according to claim 7 or 8, wherein
the crash-safe control device is operable to control a moment of initiation of

an operation of the operating device such that the moment of initiation when the possibility of crashing between the first vehicle and the at least one non-first preceding object is relatively high is advanced with respect to that when the possibility is relatively low.

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10. The crash-safe vehicle control system according to any one of claims 7-9, wherein the crash-safe control device is operable to control the operating device such that an effect to be achieved by the operation of the operating device when the possibility of crashing between the first vehicle and the at least one non-first preceding object is relatively high is increased with respect to that when the possibility is relatively low.

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15. The crash-safe vehicle control system according to any one of claims 2-10, wherein the object-information obtaining device obtains, as the object information on the at least one non-first preceding object, the information on a second preceding vehicle existing immediately in front of the first preceding vehicle, and the crash-safe control devices is operable to estimate a deceleration value of the second preceding vehicle on the basis of the obtained information on the second preceding vehicle, and control the operating device on the basis of the estimated deceleration value of the second preceding vehicle.

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20. The crash-safe vehicle control system according to claim 11, wherein the crash-safe control device is operable to control a moment of initiation of an operation of the operating device such that the moment of initiation when the estimated deceleration value of the second preceding vehicle is relatively high is advanced with respect to that when the estimated deceleration value is relatively low.

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13. The crash-safe vehicle control system according to claim 11 or 12, wherein the crash-safe control device is operable to control the operating device such that an effect to be achieved by the operation of the operating device when the estimated deceleration value of the second preceding vehicle is relatively high is increased with respect to that when the estimated deceleration value is relatively low.

14. The crash-safe vehicle control system according to any one of claims

2-13, wherein the object-information obtaining device obtains the information on the first preceding vehicle, as the object information on one of said at least one preceding object, and the crash-safe control device is operable to estimate at least one relationship value indicative of a
5 relationship between the first preceding vehicle and said at least one non-first preceding object, on the basis of the information on the first preceding vehicle and said non-first preceding-object information on the at least one non-first preceding object, which have been obtained by the object-information obtaining device, said at least one relationship value
10 beings selected from a distance between the first preceding vehicle and one of the at least one non-first preceding object, a time up to a moment of arrival of the first preceding vehicle at a present position of said one non-first preceding object, and a time up to a moment of crashing of the fist preceding vehicle with said one non-first preceding object, the crash-safe
15 control device controlling the operating device on the basis of the estimated at least one relationship value.

15. The crash-safe vehicle control system according to claim 14, wherein the object-information obtaining device obtains the information on a second preceding vehicle existing immediately in front of the first preceding vehicle, as the object information on said one non-first preceding object, and the crash-safe control device is operable to estimate, as the at least one relationship value, at least one of the distance between the first and second preceding vehicles, the time up to the moment of arrival of the first preceding vehicle with the second preceding vehicle, and the time up to the moment of crashing of the first preceding vehicle with the second preceding vehicle, on the basis of the information on the first preceding vehicle and the information on the second preceding vehicle, which have been obtained by the object-information obtaining device, the crash-safe control device controlling the operating device on the basis of the estimated at least one of said distance and times.
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16. The crash-safe vehicle control system according to claim 14 or 15, wherein the crash-safe control device is operable to control a moment of initiation of an operation of the operating device such that the moment of initiation when the estimated at least one relationship value is relatively
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small is advanced with respect to that when the estimated at least one relationship value relatively large.

17. The crash-safe vehicle control system according to any one of claims
5 14-16, wherein the crash-safe control device is operable to control the operating device such that an effect to be achieved by the operation of the operating device when the estimated at least one relationship value is relatively small is increased with respect to that when the estimated at least one relationship value is relatively large.

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18. The crash-safe vehicle control system according to any one of claims
2-17, wherein the object-information obtaining device includes an operating-state-information obtaining device arranged to obtain operating-state information indicative of an operating state of a preceding
15 vehicle which is one of the at least one preceding object, and the crash-safe control device is operable to control the operating device on the basis of the operating-state information obtained by the operating-state-information obtaining device.

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19. The crash-safe vehicle control system according to claim 18, wherein the operating-state-information obtaining device includes a preceding-vehicle monitoring camera device operable to monitor the preceding vehicle, and is operable to obtain, as the operating-state information, an operating state of each of at least one of a brake lamp and a hazard lamp provided on the preceding vehicle, on the basis of image data obtained by the preceding-vehicle monitoring camera device, and the crash-safe control device is operable to control the operating device on the basis of the obtained operating state of each of the at least one of the brake lamp and the hazard lamp.

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20. The crash-safe vehicle control system according to claim 18 or 19, wherein the operating-state-information obtaining device includes a receiver device operable to receive the operating-state information transmitted by radio communication, and the crash-safe control device is operable to control the operating device on the basis of the operating-state information received by the receiver device.

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21. The crash-safe vehicle control system according to any one of claims 1-20, wherein the crash-safe control device is operable to effect at least the width-related-information-dependent control.

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22. The crash-safe vehicle control system according to claim 21, wherein the object-information obtaining device includes a width-related-information obtaining device operable to obtain the width-related information relating to said at least one specific object.

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23. The crash-safe vehicle control system according to claim 22, wherein the width-related-information obtaining device includes an object-imaging camera device operable to take an image of each of the at least one preceding object, and an image-data processing device operable to process image data representative of the image taken by the object-imaging camera device, for obtaining the width-related information on each of the at least one specific object.

24. The crash-safe vehicle control system according to claim 22 or 23, wherein the object-information obtaining device includes an object detecting radar device operable to detect said at least one preceding object, in addition to the width-related-information obtaining device.

25. The crash-safe vehicle control system according to claim 24, wherein the object detecting radar device is operable to obtain information relating to an approximate position of each of the at least one preceding object, and the width-related-information obtaining device is operable to obtain the width-related information on each of the at least one specific object, on the basis of the information relating to approximate position obtained by the object detecting radar device.

26. The crash-safe vehicle control system according to claim 24 or 25, wherein the width-related-information obtaining device selects said at least one specific object from said at least one preceding object detected by the object detecting radar device, and obtains the width-related information on each of the at least one specific object.

27. The crash-safe vehicle control system according to any one of claims 21-26, wherein the crash-safe control device is operable to control the operating device on the basis of the widthwise center position of the at least one specific object represented by the width-related information.
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28. The crash-safe vehicle control system according to any one of claims 21-27, wherein the crash-safe control device is operable to control the operating device, on the basis of at least one of widthwise opposite positions of each of the at least one specific object which are represented by the width-related information.
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29. The crash-safe vehicle control system according to any one of claims 21-28, wherein the crash-safe control device is operable to estimate, on the basis of the width-related information the at least one specific object, a lap ratio of the own vehicle and each of the at least one specific object, said lap ratio being a ratio of an overlapping width of the own vehicle with respect to its overall width, which is expected if the own vehicle collides with said each specific object over said overlapping width, the crash-safe control device being operable to control the operating device on the basis of the estimated lap ratio.
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30. The crash-safe vehicle control system according to claim 29, wherein the crash-safe control device is operable to control a moment of initiation of an operation of the operating device such that the moment of initiation when the estimated lap ratio is relatively high is advanced with respect to that when the possibility is relatively low.
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31. The crash-safe vehicle control system according to claim 29 or 30, wherein the crash-safe control device is operable to control the operating device such that an effect to be achieved by the operation of the operating device when the estimated lap ratio is relatively high is increased with respect to that when the estimated lap ratio is relatively low.
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32. The crash-safe vehicle control system according to any one of claims 21-31, wherein the crash-safe control device is operable to determine, on the basis of the width-related information on said at least one specific object,

whether each of the at least one specific object lies on an own lane on which the own vehicle is to run, and control the operating device on the basis of a result of said determination.

- 5 33. The crash-safe vehicle control system according to claim 32, wherein the crash-safe control device is operable to determine that each of the at least one specific object lies on the own lane, when said each specific object is at least partly located within a width of the own lane.
- 10 34. The crash-safe vehicle control system according to any one of claims 21-33, wherein the object-information obtaining device is operable obtain the width-related information on each of at least one specific preceding vehicle each of which is one of said at least one specific object and is a preceding vehicle existing in front of the own vehicle, and the crash-safe control device 15 is operable to control the operating device on the basis of the width-related information on each of the at least one specific preceding vehicle.
- 20 35. The crash-safe vehicle control system according to claim 1, wherein the crash-safe control device is operable to effect both of the non-first-preceding-object-information-dependent control and the width-related-information-dependent control.